HIGH PERFORMANCE CONCRETE QUESTIONNAIRE - 2003
Revision 1: Dec. 30, 2003
Revision 2: May 15, 2004
Revision 3: July 22, 2004

State: _____**SUMMARY**_____

1. Which of the following changes have been made to your concrete specifications in the last 10 years?

Question 1	Changes Made in Last 10 Yrs	Included in Current Specs.
	% Responded YES	% Responded YES
Use HPC - low permeability concrete	77%	60%
Use HPC-high strength concrete	58%	47%
Allow admixtures	57%	79%
Concrete Strengths	74%	79%
Bridge Deck curing	75%	81%
Deck finishing requirements	47%	70%
Limit cement/alkali content	32%	57%
Testing and acceptance requirements	62%	83%
Heat of hydration required for cement	8%	13%
Chloride testing of hardened concrete	28%	25%
Lightweight concrete	26%	23%
Self-consolidating concrete (SCC) in use	36%	17%
Flowing concrete in use	25%	25%
Epoxy coated reinf. steel used	34%	75%
Stainless Steel reinf. steel used	26%	6%
Stainless Clad reinf. steel used	21%	6%
Specify air void param. (spac. factor and/or specific surface)	4%	6%

2. Current Concrete Specifications:

QUESTION 2 - Current Specification Summary/Ranges								
CLASS OF CONCRETE	**Air Content %**	**Air Content %**	**Max. W/C Ratio**	**Slump (in.)**	**Cement Type**	**Min. Cement Content (lb/cy)**	**Max. Cement Content (lb/cy)**	**Max. Aggreg. Size (in.)**
Prestressed	0 - 10%	0 - 10%	0.315 - 0.5	0 - 10	I, II, III and other types	400 - 840	550 - 893	0.5 - 1.5
Decks	1 - 10%	1 - 10%	0.35 - 0.52	0 - 9	I, II, III and other types	400 - 705	0 - 850	0.5 - 1.5
Parapets	1 - 10%	1 - 10%	0.35 - 0.53	0 - 9	I, II, III and other types	400 - 710	80 - 850	0.375 - 2
Substructure/General	0 - 10%	0 - 10%	0.35 - 0.55	0 - 9	I, II, III and other types	400 - 705	0 - 850	0.5 - 2
Paving	1 - 10%	1 - 10%	0.4 - 0.559	0 - 9	I, II, III and other types	508 - 705	600 - 800	0.75 - 3
Latex Hydraulic Cement Concr.	0 - 10%	0 - 10%	0.22 - 0.4	2 - 9	I, II, III and other types	6.6 - 752	658 - 752	0.375 - 1.25
Silica Fume Concrete	1 - 9%	1 - 9%	0.33 - 0.42	2 - 8	I, II, III and other types	564 - 752	0 - 850	0.375 - 1.5

Highest Compr. strength used for prestr. concrete girders:	5 - 12	ksi
Compressive concrete strength used for decks:	3.1 - 6	ksi

3. All states have experienced some of the below concrete distresses. To what extent has your State experienced these (Rank from 1 to 5 with 1=rare and 5=often):

QUESTION 3 SUMMARY (NUMBER OF STATES)							
Type of Distress	**RANK**	**RANK**	**RANK**	**RANK**	**RANK**	**NO RANK**	**WEIGHTED SUM**
	1	**2**	**3**	**4**	**5**	**--**	
Corrosion of Reinforcing Steel	7	6	17	13	9	1	167
Sulfate Attack	33	14	1	4	0	1	80
Alkali-silica Reactivity	26	11	9	5	0	2	95
Freezing and Thawing	16	10	13	7	5	2	128
Cracking (girders, substr., pvmt)	7	13	15	11	5	2	147
Deck Cracking(Early age<5 yrs.)	4	7	12	18	12	0	186
Overload	27	12	5	1	2	6	80
Poor Construction Quality	12	19	13	6	2	1	123

QUESTION 3 SUMMARY (PERCENT OF STATES)							
Type of Distress	**RANK**	**RANK**	**RANK**	**RANK**	**RANK**	**NO RANK**	**WEIGHTED SUM**
	1	**2**	**3**	**4**	**5**	**--**	
Corrosion of Reinforcing Steel	13%	11%	32%	25%	17%	2%	167
Sulfate Attack	62%	26%	2%	8%	0%	2%	80
Alkali-silica Reactivity	49%	21%	17%	9%	0%	4%	95
Freezing and Thawing	30%	19%	25%	13%	9%	4%	128
Cracking (girders, substr., pvmt)	13%	25%	28%	21%	9%	4%	147
Deck Cracking(Early age<5 yrs.)	8%	13%	23%	34%	23%	0%	186
Overload	51%	23%	9%	2%	4%	11%	80
Poor Construction Quality	23%	36%	25%	11%	4%	2%	123

4. Construction Requirements:
Workability Requirements:

Question 4 - Part 1 & 2	NON-AGGR. ENVIR. (Part 1)	AGGRESSIVE ENVIR. (Part 2)
	% of 53* States that responded <YES>	% of 53* States that responded <YES>
Air-Entraining	79%	92%
Retarding	68%	75%
Accelerating	42%	38%
Water Reducing (Normal)	75%	81%
Water Reducing (High Range)	77%	81%
Water Reducing & Retarder	64%	72%
Water Reducing & Accelerator	34%	32%
Viscosity Modifying Admixtures	15%	19%
Silica Fume	45%	70%
Fly Ash, Class F	70%	77%
Fly Ash, Class C	49%	57%
Fly Ash, Class N	8%	8%
Metakaolin	8%	11%
Rice Hull Ash	4%	4%
Other Ash Materials	2%	2%
Bark Ash	2%	2%
Bottom Ash	0%	0%
Pet Coke Ash	2%	2%
Slag	57%	62%
Latex	26%	36%
Corrosion Inhibitors	25%	42%

QUESTION 4 Part 3	ELEMENTS WHERE USED									
	Number of States									
ADMIXTURE/SLAG	**ALL**	**Deck**	**Girder**	**Pier**	**Footing**	**Concrete Pile**	**Drilled Shaft**	**Overlay**	**Blank**	**Other**
Air-Entraining	36	11	4	8	4	3	1	0	0	0
Retarding	30	13	6	6	4	5	6	0	0	0
Accelerating	18	3	6	5	3	3	2	1	1	1
Water Reducing (Normal)	35	7	3	5	1	2	1	0	8	1
Water Reducing (High Range)	23	11	15	12	5	10	7	0	6	4
Water Reducing & Retarder	26	11	7	6	4	6	4	0	12	2
Water Reducing & Accelerator	15	2	4	3	1	3	1	0	31	1
Viscosity Modifying Admixtures	4	1	6	2	1	2	1	0	38	2
Silica Fume	10	25	9	7	2	4	0	1	15	1
Fly Ash, Class F	28	9	6	7	3	5	1	0	10	3
Fly Ash, Class C	21	6	5	6	2	5	1	0	19	3
Fly Ash, Class N	4	2	2	1	1	1	0	0	43	1
Metakaolin	3	4	0	1	1	1	0	0	41	1
Rice Hull Ash	3	1	0	0	0	0	0	0	46	0
Other Ash Materials	2	0	1	0	0	0	0	0	48	0
Bark Ash	3	0	0	0	0	0	0	0	48	0
Bottom Ash	2	0	0	0	0	0	0	0	50	0
Pet Coke Ash	3	0	0	0	0	0	0	0	48	0
Slag	23	9	5	7	5	3	2	1	15	2
Latex	3	18	1	1	0	1	0	4	26	2
Corrosion Inhibitors	6	10	10	8	3	5	1	0	28	0

Question 4 - Part 4	Range
Admixture Type and Slag	
Fly Ash	0 - 40%
Slag	0 - 75%
Silica Fume	0 - 15%
Metakaolin	0 - 20%
Rice Hull Ash	0 - 22%
Other Ash Material	0 - 30%

Question 4 - Part 5	% of 53* States that responded <YES>
Allowed Practice for Placing Concrete on Site	
Is water allowed to be added at the job site?	85%
Are air-entraining admixtures allowed to be added at the job site?	58%
Are accelerators added at the job site?	36%
Are there any special finishing requirements?	42%

Question 4 - Part 6 - CURING REQUIREMENTS						
Structural Element	**Exist. Spec. <YES>**	**Curing Comp. <YES>**	**Fog Mist <YES>**	**Wet Burlap (days)**	**ERL LB/SF/HR**	**Cure Time (days)**
Decks	89%	60%	55%	1 - 14	0 - 1	3 - 28
Silica Fume Overlay	47%	26%	43%	1 - 10	0.1 - 1	1 - 28
Latex Concrete Overlay	42%	11%	23%	0 - 7	0 - 0.15	1 - 7
Dense Concrete Overlay	34%	21%	13%	0 - 7	0.1 - 1	3 - 28
Paving	70%	70%	13%	0 - 7	0 - 0.2	0 - 14
Shotcrete	26%	25%	6%	0 - 7	0 - 0.1	0 - 7
Shotcrete with SF	15%	13%	6%	0 - 7	0 - 0.1	0 - 10
Massive Element	30%	15%	9%	0 - 14	0 - 0	3 - 28

Question 4 - Part 7: Evaporation Requirement	% of 53* States that responded <YES>
Any construction requirements for reducing evaporation?	64%
HOW?	4%
How often? (minutes)	0 - 180 min.

5. Has fiber-reinforced concrete been specified for bridge decks or overlays and paving (either steel or plastic fibers)(Indicate R = Regular and E = Experimental.)

Question 5		
	% of 53* States that responded <YES>	**% of 53* States that responded (EXP)**
Bridge decks: Fiber reinf. concrete specified?	19%	15%
Fiber Type: Steel	9%	
Fiber Type: Plastic	26%	
Overlays: Fiber reinf. concrete specified?	28%	13%
Fiber Type: Steel	13%	
Fiber Type: Plastic	30%	
Paving: Fiber reinf. concrete specified?	13%	10%
Fiber Type: Steel	4%	
Fiber Type: Plastic	0%	

6. Identify concrete cover requirements:

QUESTION 6 - MINIMUM COVER REQUIREMENTS		
STRUCTURAL ELEMENT	**COVER (inches)**	
	Part 1: Non-Aggressive Environment	**Part 2: Aggressive Environment**
Deck - Top	1.5 - 3	2 - 3
Deck - Bottom	1 - 3	1 - 3
Reinforced Concrete Beams	1 - 3	1 - 3
Prestr. Concr. Beams - CIP	1 - 3	1 - 3
Prestr. Concr. Beams - Precast	1 - 3	1 - 4
Substructure - Piers	1.5 - 5	1.5 - 6
Substructure - Abutments	1.5 - 3	1.5 - 4
Substructure - Footings	2 - 4	1.5 - 4
Substructure - Drilled Shaft	3 – 6	3 - 6

QUESTION 6 - REQUIRED REINFORCING STEEL									
STRUCTURAL ELEMENT	TYPE REINFORCING STEEL Part 3 - Non-Aggressive Environment								
	BS	ECS	GS	SS	SCD	MMFX	No Response	Other Comments*	Not Used
Decks – Top	26%	62%	8%	0%	0%	0%	13%	2%	0%
Decks – Bottom	34%	53%	8%	0%	0%	0%	13%	0%	2%
Reinforced Concrete Beams	45%	25%	4%	0%	0%	0%	26%	0%	8%
Prestressed Concrete Beams, CIP	38%	23%	4%	0%	0%	0%	32%	0%	11%
Prestressed Concrete Beams, Precast	62%	34%	8%	0%	0%	0%	13%	0%	2%
Substructure – Piers	66%	28%	9%	0%	0%	0%	9%	0%	2%
Substructure – Abutments	68%	28%	8%	0%	0%	0%	9%	0%	2%
Substructure - Footings	70%	21%	8%	0%	0%	0%	9%	0%	2%

QUESTION 6 - REQUIRED REINFORCING STEEL									
STRUCTURAL ELEMENT	TYPE REINFORCING STEEL Part 4 - Aggressive Environment								
	BS	ECS	GS	SS	SCD	MMFX	No Response	Other Comments*	Not Used
Decks – Top	9%	89%	9%	4%	0%	0%	4%	0%	0%
Decks – Bottom	21%	77%	9%	4%	0%	0%	4%	0%	0%
Reinforced Concrete Beams	32%	43%	6%	4%	0%	0%	23%	0%	6%
Prestressed Concrete Beams, CIP	28%	42%	4%	4%	0%	0%	25%	0%	11%
Prestressed Concrete Beams, Precast	51%	55%	8%	4%	0%	0%	8%	0%	0%
Substructure – Piers	47%	57%	11%	2%	0%	0%	4%	0%	2%
Substructure – Abutments	47%	57%	9%	2%	0%	0%	4%	0%	0%
Substructure - Footings	57%	40%	9%	2%	0%	0%	4%	0%	0%

QUESTION 6 - REQUIRED REINFORCING STEEL									
STRUCTURAL ELEMENT	TYPE REINFORCING STEEL Part 5 – Experimental Use								
	BS	ECS	GS	SS	SCD	MMFX	No Response	Other Comments*	Not Used
Decks – Top	0%	0%	8%	19%	25%	21%	55%	0%	0%
Decks – Bottom	0%	0%	6%	17%	23%	21%	55%	0%	0%
Reinforced Concrete Beams	0%	0%	0%	4%	4%	2%	92%	0%	4%
Prestressed Concrete Beams, CIP	0%	0%	0%	2%	2%	2%	94%	0%	4%
Prestressed Concrete Beams, Precast	0%	0%	0%	2%	2%	4%	94%	0%	2%
Substructure – Piers	2%	0%	4%	6%	6%	8%	85%	0%	2%
Substructure – Abutments	2%	0%	2%	4%	4%	6%	89%	0%	2%
Substructure - Footings	2%	0%	0%	4%	4%	6%	91%	0%	2%

7. Is there a limit on the percent of alkali allowed in the cement?

8. Are aggregates tested for reactivity? (Part 1)

How many sources of aggregates? (Part 2)

QUESTION 7 & 8		**% of 53* States that responded <YES>**
# 7	***Is there a limit on the percent of alkali allowed in the cement? [YES=1, NO=0]***	66%
# 8 - Part 1	***Are the aggregates tested for reactivity? [YES=1, NO=0]***	64%
# 8 - Part 2	***How many sources of aggregates? [YES=1, NO=0]***	66%

9. Indicate specification permeability requirement limits for:

Question 9	PERMEABILITY RANGE (Coulombs)	
Structural Element	**Non-Aggressive Environment Part 1**	**Aggressive Environment Part 2**
Bridge Decks	750 - 4000	750 - 4000
Prestressed Concrete Members	1000 - 2500	800 - 2500
Substructure Elements	1000 - 4000	800 - 4000
Pavements	2000 - 3500	2000 - 3500

Question 9	BRIDGE DECKS		PRESTRESSED CONCRETE MEMBERS	
Coulomb Range	**Number of States**		**Number of States**	
	Non-Aggressive Environment Part 1	**Aggressive Environment Part 2**	**Non-Aggressive Environment Part 1**	**Aggressive Environment Part 2**
0-1000	3	7	1	4
1001-2000	8	11	4	4
2001-3000	2	1	1	2
3001-4000	1	1	0	0

Question 9	SUBSTRUCTURE ELEMENTS		PAVEMENT ELEMENTS	
Coulomb Range	**Number of States**		**Number of States**	
	Non-Aggressive Environment Part 1	**Aggressive Environment Part 2**	**Non-Aggressive Environment Part 1**	**Aggressive Environment Part 2**
0-1000	1	4	0	0
1001-2000	3	5	2	2
2001-3000	0	1	0	0
3001-4000	2	2	1	1

10 (a): What QC/QA tests do you specify?

Question 10(a)	
What QC/QA Test do you specify?	**% of 53* States that responded <YES>**
Fresh Concrete	
Slump	94%
Spread	11%
Unit Weight	53%
Air Content	94%
Water Content	17%
W/CM	38%
Temperature	9%

Hardened Concrete	**% of 53* States that responded <YES>**
Compressive Strength	96%
Air/Void System	8%
Chloride Permeability	36%
Maturity	9%
Freeze/Thaw	13%
Shrinkage	6%
ASR	15%

Question 10(b)	% of 53* States that responded <YES>
What are your acceptance criteria for cracks? (i.e., Do you have an acceptance criteria for cracks?)	13%

Question 10 (c)	% of 53* States that responded <YES>
Do you specify pre-construction mock-ups?	36%

Question 10(d) - Do you specify design properties at (##) days … ?	% of 53* States that responded <YES>
28 days	98%
56 days	34%
Other Duration	6%

Question 10(e)	% of 53* States that responded <YES>
Do you allow 4x8 cylinders for compressive strength tests?	57%

Question 10(f) – What types of end-caps do you specify/allow …?	% of 53* States that responded <YES>
Sulfur	77%
Neoprene	83%
Ground Ends	17%

Question 10(g)	% of 53* States that responded <YES>
Do you specify match-cured cylinders?	30%

Question 10(h)	% of 53* States that responded <YES>
How do you enforce/monitor wet-water curing?	85%

Question 10(i)	% of 53* States that responded <YES>
Do you require warrantees against defects – e.g. bridge deck cracking?	8%

Question 10(j)	% of 53* States that responded <YES>
What is your experience/evaluation/specification regarding the Microwave Test for w/cm? (i.e., Do you have experience…)	13%

11. How often are the following types of concrete overlays used? (Rank from 1 to 5 with 1=rare and 5=often)

QUESTION 11 - Part 1: USAGE (Range from 1 to 5 with 1 = rare and 5 = often)						
Type of Overlay	**1**	**2**	**3**	**4**	**5**	**WEIGHTED SUM**
Latex-modified Concrete	51%	16%	14%	12%	7%	89
Silica Fume Concrete	36%	11%	11%	18%	24%	128
Dense Concrete	56%	17%	11%	3%	14%	73
Fly Ash Concrete	45%	17%	3%	14%	21%	72
Slag Concrete	59%	7%	7%	14%	14%	63
Epoxy (Thin Bonded)	74%	20%	3%	3%	0%	47
Polymer (Thin Bonded)	77%	17%	0%	7%	0%	41
Other	54%	8%	15%	8%	15%	29

QUESTION 11 - Part 2	**COMMENTS ON PERFORMACE**			
Type of Overlay	**EXCELLENT**	**GOOD**	**POOR**	**NO RATING**
Latex-modified Concrete	21%	26%	4%	49%
Silica Fume Concrete	15%	38%	6%	42%
Dense Concrete	9%	19%	0%	72%
Fly Ash Concrete	19%	9%	0%	72%
Slag Concrete	9%	13%	2%	75%
Epoxy (Thin Bonded)	2%	21%	6%	72%
Polymer (Thin Bonded)	4%	9%	6%	81%
Other	4%	6%	0%	91%

12. Rank the need or interest for your State to learn more about the following from 1 to 5 (1=low; 5=very high)

Question 12 - PART 1						
Beneficial Attributes	**INTEREST LEVEL (1 = LOW, 5 = VERY HIGH**					**WEIGHTED SUM - BENEFICIAL ATTRIBUTES**
	1	**2**	**3**	**4**	**5**	
Low Perm. Conc. (Dense Conc)	19%	11%	17%	13%	40%	182
High Durability	13%	6%	19%	21%	42%	197
High Corrosion Resistance	9%	17%	23%	19%	32%	184
Alkali-silica reactivity Resistance	25%	17%	27%	10%	21%	148
Higher Concrete Strengths	19%	23%	43%	4%	11%	141
Highly Flowable Concrete	9%	13%	28%	28%	21%	179
Crack Control	2%	8%	23%	17%	51%	216
Skid Resistance	14%	27%	39%	10%	10%	140
Rideability	17%	19%	35%	15%	13%	150
Toughness of Concrete*	16%	22%	39%	16%	8%	142
Minimum Maintenance	8%	10%	35%	25%	23%	180
Longer Service Life	8%	4%	23%	23%	43%	207
Savings (life Cycle Costs)	12%	8%	27%	25%	29%	183

QUESTION 12 - Part 2														
BENEFICIAL ATTRIBUTES	Overall Ranking													WEIGHTED SUM OVERALL RANKING
	1	2	3	4	5	6	7	8	9	10	11	12	13	
Low Perm. Conc. (Dense Conc)	15%	12%	23%	12%	4%	4%	0%	4%	12%	0%	8%	4%	4%	133
High Durability	38%	19%	12%	0%	12%	0%	4%	8%	0%	4%	0%	4%	0%	89
High Corrosion Resistance	4%	19%	8%	19%	15%	8%	12%	8%	0%	8%	0%	0%	0%	126
Alkali-silica reactivity Resistance	5%	5%	18%	0%	14%	5%	5%	14%	9%	0%	5%	14%	9%	158
Higher Concrete Strengths	0%	0%	0%	0%	8%	4%	4%	4%	13%	13%	33%	4%	17%	240
Highly Flowable Concrete	4%	13%	0%	9%	4%	4%	13%	0%	13%	4%	4%	17%	13%	182
Crack Control	27%	8%	12%	12%	12%	12%	4%	4%	4%	4%	4%	0%	0%	110
Skid Resistance	0%	0%	0%	4%	4%	4%	13%	4%	17%	9%	22%	17%	4%	216
Rideability	0%	0%	0%	4%	4%	17%	4%	8%	8%	29%	13%	8%	4%	214
Toughness of Concrete*	0%	0%	0%	13%	8%	4%	8%	13%	13%	8%	17%	4%	13%	208
Minimum Maintenance	4%	4%	4%	13%	9%	17%	9%	13%	9%	13%	4%	0%	0%	149
Longer Service Life	13%	13%	17%	13%	8%	8%	13%	4%	4%	0%	8%	0%	0%	115
Savings (life Cycle Costs)	0%	9%	9%	13%	13%	13%	13%	13%	0%	4%	13%	0%	0%	143

13. Who at State and Division levels i.e., Materials, Construction, Pavement, Research, Structures, would be involved in examining concrete specifications and procedures and learning about High Performance Concrete?

Check those that apply:

QUESTION 13	
Responsible Individual	**% of 53* States that responded <YES>**
Materials	98%
Construction	79%
Pavement	45%
Structures	89%
Research	55%

14. Have you considered adopting/implementing the following SHRP products?

QUESTION 14				
SHRP Products	**% of 53* States that responded <YES>**	**% of 53* States that responded <NO>**	**% of 53* States that responded <Unknown>**	**% of 53* States that responded <Implemented>**
2005	27%	40%	31%	2%
2014	46%	21%	15%	17%
2017	20%	45%	18%	18%
2036	20%	30%	42%	8%